



# 习题

1. 证明平行移轴定理
2. 用牛顿欧拉法做Craig教材《机器人学导论》习题6.5
3. 用拉格朗日法做Craig教材《机器人学导论》习题6.20
4. 考虑拉格朗日函数  $L(\Theta, \dot{\Theta}) = k(\Theta, \dot{\Theta}) - u(\Theta)$ , 其中  $\Theta = [q_1, q_2, \dots, q_n]$ ,  $k(\Theta, \dot{\Theta}) = \frac{1}{2} \dot{\Theta}^T M(\Theta) \dot{\Theta} = \frac{1}{2} \sum_{i,j} m_{ij} \dot{q}_i \dot{q}_j$ 。证明：

$$\sum_{i,j} \left\{ \frac{\partial m_{kj}}{\partial q_i} \right\} \dot{q}_i \dot{q}_j = \frac{1}{2} \sum_{i,j} \left\{ \frac{\partial m_{kj}}{\partial q_i} + \frac{\partial m_{ki}}{\partial q_j} \right\} \dot{q}_i \dot{q}_j$$